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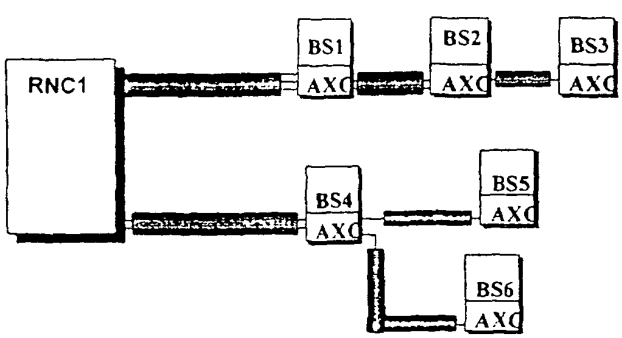
(54) Title: CONFIGURING A DATA TRANSMISSION INTERFACE IN A COMMUNICATION NETWORK

BSS/RAN area (RNC + BTSs)



(57) Abstract: The present invention proposes a method for configuring a data transmission interface in a communication network adopting a transmission protocol for transmission of data in units of grouped data, wherein said transmission interface is the interface (Iub) between an access network control node (RNC1) and an access node (BS1-BS6) adapted to establish a communication to a terminal, and wherein said communication network has a topology such that an access node (BS2, BS3, BS5, BS6) is connected to said access network control node (RNC1) by an intermediate of at least one further access node (BS1,BS1-BS2, BS4, BS4), said method comprising the steps of: deriving a delay information of the delay experienced by data transmission between a respective network access node (BS1-BS6) and said access network control node (RNC), calculating a delay difference between two consecutive access nodes (BS1-BS2, BS2-BS3, BS4-BS5, BS4-BS6) based on said delay information, and modifying the delay experienced by data transmission for the respective access node which is identified by the respective smaller delay. Also, the present invention proposes an accordingly adapted access network control node as well as accordingly adapted access nodes.

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TITLE OF THE INVENTION

CONFIGURING A DATA TRANSMISSION INTERFACE IN A COMMUNICATION NETWORK

FIELD OF THE INVENTION

The present invention relates to a method for configuring a data transmission interface in a communication network adopting a transmission protocol for transmission of data in units of grouped data.

BACKGROUND OF THE INVENTION

Typically, a communication network comprises a core network which is independent of the connection technology used and handles "administrative" topics occurring in the network, as well as an access network. The access network is in charge of enabling terminals to access the communication network for communicating via the network with other terminals. The access network is dependent on the technology used for establishing connection with terminals (e.g. wireless or non-wireless connection).

For explanatory purposes only, the present description focuses on a wireless access network which is commonly referred to as radio access network (RAN), since it enables terminals to access the network via an air-interface. Thus, the radio access network RAN as referred to in the present description means a so-called 3rd generation RAN (3GRAN) conforming to the standards elaborated by the 3rd generation partnership project (3GPP).

Nevertheless, the principles as outlined in the present invention are intended to be understood in its broadest

sense. Therefore, it is pointed out here that the communication network described in the present description is intended to mean any communication network, whether for mobile or non-mobile communication, as long as the communication network utilizes a packet or cell switched transmission protocol, i.e. a transmission protocol for transmission of data in units of grouped data. Examples for such transmission protocols are the Asynchronous Transmission Mode (ATM) protocol or the Internet Protocol (IP). ATM may be used in connection with an access network or base station subsystem (BSS) operated on the basis of Wideband Code Divisional Multiple Access WCDMA, while IP may be used in connection with a base station subsystem (BSS) operated on the basis of Wideband Code Divisional Multiple Access WCDMA or operated fully on the basis of the IP protocol.

As regards the constitution and/or topology of the radio access network, a plurality of base stations BS (also referred to as Node_B) are provisioned as access nodes for establishing connection with terminals (mobile station MS or user equipment UE). The access nodes are in turn controlled by a radio network controller RNC (corresponding to a base station controller BSC in GSM systems).

The base stations BS are connected to the radio network controller RNC such that at least one access node (base station) is connected to said access network control node (radio network controller) by an intermediate of at least one further access node. (There may also be access nodes that do not have any intermediate nodes, like BS1 and BS4, as shown in Fig. 2.) Stated in other words, the base stations are provided in respective chains of typically two to five (or more) base stations, while a plurality of such chains may be connected in a star connection type to the

radio network controller. Still further, within a chain of base stations, the chain may be branched to two or more branches. Fig. 2 shows an example for the topology of a radio access network RAN in which the base stations BS1 to BS6 are each provided with an ATM Cross Connect means AXC.

The interface via which the access nodes (base stations) communicate with the control node (radio network controller) is known as the Iub interface (corresponding to the Abis interface in GSM). Data transport via the Iub interface, however, is subject to delays and delay variations. A main objective in network design is the minimization of imposed delays and also the minimization of delay variations. The delays are typically caused due to network design particulars, and once a network topology has been chosen, the delays can not be altered any more. On the other hand, delay variations are often created by a mechanism that allows at least some trade-off between delay variation and network capacity utilization, i.e. the higher the capacity utilization is chosen, the higher delay variations are accepted, while the lower the capacity utilization is chosen, the smaller are the delay variations to be taken into account.

In connection with data transmission via the Iub interface, the Iub transport delay and delay variations are due to an accumulation of individual delays/delay variations originating from several components:

- AAL2 (ATM Adaptation Layer type 2) shaping,
- AAL2 multiplexing,
- ATM multiplexing and switching and
- transmission (via the physical transmission media).

Delay components as briefly introduced before are graphically represented in Fig. 1 for the case of a WCDMA

transmission based base station subsystem BSS of the radio access network RAN. For a WCDMA based BSS, the delay components for transmission/transport include

- AAL2 multiplexing,
- ATM multiplexing
- PDH/SDH multiplexing (Plesiochronous Digital Hierarchy / Synchronous Digital Hierarchy) and
- the physical transmission media (such as the microwave radio, fibres, copper wires etc.).

A total value of delay / delay variation between any base station BS and/or base transceiver station BTS and the radio network controller RNC is fixed and constant for every base station BS.

Now, with regard to Fig. 1, one could imagine the delay components in a vertical column in the drawing representation to correspond to an individual base station, while for a chained base station topology as shown in Fig. 2, the delays imposed on data transmission of individual columns would have to be added for obtaining the overall delay. In this model, it has to be noted that for each base station BS connection to the RNC, only one AAL2 multiplexing delay will be relevant, since the data need not be ATM adapted before reaching the RNC. Also, the dashed boxes in Fig. 1 indicate a not necessarily provided intermediate equipment operating up to and including the ATM layer.

Thus, Fig. 1 could be interpreted (when neglecting the dashed column in the middle) such that the left column represents base station BS4 in Fig. 2, while the right column represents the base station BS5 (or BS6) in Fig. 2.

Apparently, it can then be observed that the ATM switching delays and delay variations as well as the transmission delays heavily depend on the position of the respective base station in the topology of the transport and transmission network, which positions could qualitatively be characterized by the words "near" (e.g. BS4) or "far" (e.g. BS5 or BS6). This observation may be based on the model shown in Fig. 1 but also from the topology shown in Fig. 2, from which it becomes clear that BS1 being closer to the RNC than BS3 has inherently a lower transmission delay than BS3, and also that BS4 has inherently a lower transmission delay than BS5 (or BS6).

Just to give a numerical example, in such a topology ATM connections going up to the farthest base station are estimated to experience e.g. 5 ms longer delays or delay variations than ATM connections going to the nearest base station. Due to macrodiversity, however, the radio access network application can hardly make use of the maximum 5 ms delay advantage that the nearer base stations have over the farthest one, so that the transport capacity utilization on the Iub interface is non-optimum.

The transport capacity utilization on the Iub interface, however, is rather crucial, since the Iub links requirements are often tight, especially when radio transmisison is used (but also when wired transmission types are used). Thus, in existing scenarios, a capacity utilization of the Iub interface in the radio access networks is non-optimum.

A previous approach as proposed for standardization in the 3GPP is based on a fixed usage of the same fixed delay for AAL2/ATM delay for ATM packetization, multiplexing and depacketization on the Iub interface. The fixed value has

been proposed to be 7 ms. Thus, with reference to Fig. 1, according to this proposal one source of additional delay variation has been removed by summarizing AAL2 multiplexing and ATM multiplexing blocks to a single delay component, while remaining delay variations (due to PDH/SDH multiplexing and/or used physical media) still adversely affect the capacity usage on the Iub interface.

SUMMARY OF THE INVENTION

Hence, it is an object of the present invention to improve the capacity utilization for the interface between the network access nodes and the access network control node.

According to the present invention, the above object is for example achieved by a method for configuring a data transmission interface in a communication network adopting a transmission protocol for transmission of data in units of grouped data, wherein said transmission interface is the interface between an access network control node and an access node adapted to establish a communication to a terminal, and wherein said communication network has a topology such that an access node is connected to said access network control node by an intermediate of at least one further access node, said method comprising the steps of: deriving a delay information of the delay experienced by data transmission between a respective network access node and said access network control node, calculating a delay difference between two consecutive access nodes based on said delay information, and modifying the delay experienced by data transmission for the respective access node which is identified by the respective smaller delay.

According to further developments of the present invention

- said modifying resides in increasing the delay experienced by data transmission for the respective access node which is identified by the respective smaller delay;
- said delay is increased by the amount of the delay difference;
- the delay experienced by data transmission between a respective access node and said network control node is composed by a transmission and switching delay component and an adaptation layer delay component;
- said modifying affects said adaptation layer delay component;
- the adaptation layer delay component of the access node of consecutively arranged network access nodes identified by the largest delay is set to a predetermined minimum value;
- said transmission protocol is a packet switched transmission protocol;
- said transmission protocol is a cell switched transmission protocol;
- said transmission protocol is the Asynchronous Transfer Mode ATM; and
- said modifying the delay is effected by correspondingly modifying the amount of buffering of data.

Still further, the present invention addresses to an access network control node as well as to an access node, respectively adapted to be configured for implementing the above defined method.

Accordingly, the present invention enables the provision of the following advantages as compared to previous solutions:
1) the capacity utilization on the interface (Iub) is improved,
2) due to improved capacity utilization, less overall capacity is required to be provisioned,

3) transmission costs can be saved by the network operator,
4) as the Iub transmission link may consume the same amount of delay for every base station BS, those base stations located closer to the radio network controller may then utilize additional buffering (causing an increased delay) for its own traffic, with the increased buffering possibility enables larger statistical multiplexing gain while maintaining transmission quality,
5) even if AAL2 is replaced by IP(UDP) (Internet Protocol / User Datagram Protocol) then the principle of the present invention may be transferred to the IP multiplexing layer which is then allowed to show a larger multiplexing delay, thus, the present invention provides flexibility to be applied for different communication network transmission protocols.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more fully apparent upon reference to the accompanying drawings, in which:

Fig. 1 illustrates delay components of a transmission via the Iub interface, and

Fig. 2 illustrates an example of a network topology for supporting the explanation of the method according to the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The present invention will now be described in greater detail.

According to the present invention, data transmission from different base stations BS (access nodes) experiences different delays and/or delay variations dependent on the position of the base stations in a chain of consecutively arranged base stations, the chain being connected at one end to a radio network controller (access network control node). Thus, it is possible to allow the base station imposing the least delay to consume more delay.

Generally spoken, as regards a communication network having a topology such that a first access node is connected to the access network control node by an intermediate of at least one access node, a delay information of the delay experienced by data transmission between a respective network access node and said access network control node is derived, a delay difference between two consecutive access nodes based on said delay information is calculated, and the delay experienced by data transmission for the respective access node which is identified by the respective smaller delay is modified. The modification is effected such that the overall delay is made equal for each base station in a respective chain of base stations.

Thus, with reference to Fig. 2 and the upper chain of base stations, it is possible to allow more delay to be consumed for buffering at the base station BS1, without compromising quality of transmission of any of the base stations. This results in larger statistical multiplexing gain for traffic originating from base station BS1, without loss in quality. Similarly, base station BS2 may be allowed to use some more buffering than the last base station, i.e. BS3, in the chain uses.

The AAL2/ATM packetization, multiplexing and depacketization delay of the nearer base station (of a pair

of consecutive base stations in a chain) is modified by increasing the delay imposed thereby, to thereby compensate for the larger transmission and switching delay of the farther away base station(s). In this way, the capacity utilization of the virtual channels serving the near base stations can be improved.

Stated in other words, the AAL2 multiplexing delay configuration of delays and/or delay variations takes effect for those NCID VC connections (network connection identifier virtual channels) that experience smaller transmission and switching delays and delay variations.

For example, assume a case of two consecutive base stations (e.g. BS4, BS5 or BS4, BS6 in Fig. 2). Then, if the last (farthest away from the RNC) experiences a 5 ms longer delay than the first base station, these 5 ms are available for the first base station to be used at the AAL2 multiplexing layer. These additional 5 ms have a significant effect on the link utilization and the capacity savings easily amount up to several ten percent (for the traffic handled by the first base station).

In case of chained two base stations as mentioned above, the transmission and ATM switching delays (from the physical media up to the ATM multiplexing) to the near and far base stations are assumed to be 5 ms and 10 ms, respectively. According to the present invention, this is compensated by configuring the AAL2 multiplexing delays as 9 ms and 4 ms, respectively.

The 4 ms bound (minimum value) is conformant to the 3GPP proposal of having 7 ms for AAL2/ATM packetization, multiplexing and depacketization (AAL2 multiplexing & ATM multiplexing blocks in Fig. 1), if it is assumed that the

ATM multiplexing takes 2 ms of the total 7 ms budget and 1 ms is left for packetization and depacketization.

Apparently, upon configuring the AAL2 multiplexing delay as described in the numerical above, both base station will impose the identical (total) delay on data transmitted by them, and the previously present difference in delay has been compensated.

By choosing a minimum of 4 ms for AAL2 multiplexing under the assumptions made in the given example, the method according to the present invention still remains compatible to the previous 3GPP proposal.

The present invention is also related to accordingly adapted network nodes, i.e. control nodes RNC and access nodes BS. As regards the accordingly adapted control nodes RNC, in connection with the present invention implemented, these are adapted to support several AAL2 multiplexing delay bounds in the Iub. This is achieved by provisioning additional memory, for such CAC (connection admission control) algorithms to be used that require large pre-calculated tables for each QoS class. As regards the accordingly adapted access nodes, i.e. base stations BS, these are adapted such that they include a parameter representing a configurable multiplexing delay, and also a base station BS has a configurable buffer size (HW memory effect). Of course, the network management supports the configuration of the extra provisioned parameters, and also network planning tools and network dimensioning tools support a configurable delay, and dimensioning naturally has to account for the extra statistical multiplexing gain.

Accordingly, as has been described above, the present invention proposes a method for configuring a data

transmission interface in a communication network adopting a transmission protocol for transmission of data in units of grouped data, wherein said transmission interface is the interface (Iub) between an access network control node (RNC1) and an access node (BS1-BS6) adapted to establish a communication to a terminal, and wherein said communication network has a topology such that an access node (BS2, BS3, BS5, BS6) is connected to said access network control node (RNC1) by an intermediate of at least one further access node (BS1,BS1-BS2, BS4, BS4), said method comprising the steps of: deriving a delay information of the delay experienced by data transmission between a respective network access node (BS1-BS6) and said access network control node (RNC), calculating a delay difference between two consecutive access nodes (BS1-BS2, BS2-BS3, BS4-BS5, BS4-BS6) based on said delay information, and modifying the delay experienced by data transmission for the respective access node which is identified by the respective smaller delay. Also, the present invention proposes an accordingly adapted access network control node as well as accordingly adapted access nodes.

Although the present invention has been described herein above with reference to its preferred embodiments, it should be understood that numerous modifications may be made thereto without departing from the spirit and scope of the invention. It is intended that all such modifications fall within the scope of the appended claims.

In particular, although a radio network controller RNC according to 3GPP specifications is mentioned, this is intended only as an example for an access network control node without any intent to limit the present invention thereto. Similarly, although a base station BS and/or Node_B according to 3GPP specifications is mentioned as an

access node, this is intended only as an example for an access node without any intent to limit the present invention thereto.

CLAIMS

1. A method for configuring a data transmission interface in a communication network adopting a transmission protocol for transmission of data in units of grouped data,

wherein said transmission interface is the interface (Iub) between an access network control node (RNC1) and an access node (BS1-BS6) adapted to establish a communication to a terminal, and

wherein said communication network has a topology such that an access node (BS2, BS3, BS5, BS6) is connected to said access network control node (RNC1) by an intermediate of at least one further access node (BS1,BS1-BS2, BS4, BS4),

said method comprising the steps of:

deriving a delay information of the delay experienced by data transmission between a respective network access node (BS1-BS6) and said access network control node (RNC),

calculating a delay difference between two consecutive access nodes (BS1-BS2, BS2-BS3, BS4-BS5, BS4-BS6) based on said delay information, and

modifying the delay experienced by data transmission for the respective access node which is identified by the respective smaller delay.

2. A method according to claim 1, wherein said modifying resides in increasing the delay experienced by data transmission for the respective access node which is identified by the respective smaller delay.

3. A method according to claim 2, wherein said delay is increased by the amount of the delay difference.

4. A method according to claim 1, wherein

the delay experienced by data transmission between a respective access node (BS1-BS6) and said network control node (RNC) is composed by a transmission and switching delay component and an adaptation layer delay component.

5. A method according to claim 4, wherein said modifying affects said adaptation layer delay component.

6. A method according to claim 4, wherein the adaptation layer delay component of the access node (BS3, BS5, BS6) of consecutively arranged network access nodes identified by the largest delay is set to a predetermined minimum value.

7. A method according to claim 1, wherein said transmission protocol is a packet switched transmission protocol.

8. A method according to claim 1, wherein said transmission protocol is a cell switched transmission protocol.

9. A method according to claim 8, wherein said transmission protocol is the Asynchronous Transfer Mode ATM.

10. A method according to claim 1, wherein said modifying the delay is effected by correspondingly modifying the amount of buffering of data.

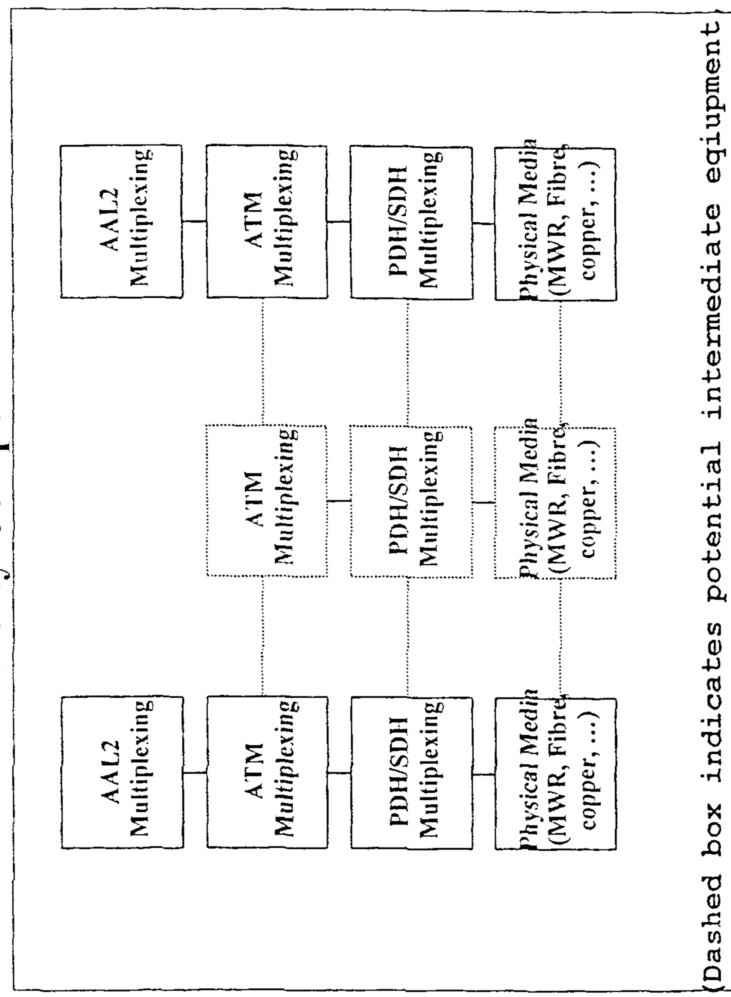
11. An access network control node adapted to be configured for implementing the method according to any of the previous claims 1 to 10.

12. An access node adapted to be configured for implementing the method according to any of the previous claims 1 to 10.

1/2

FIG. 1

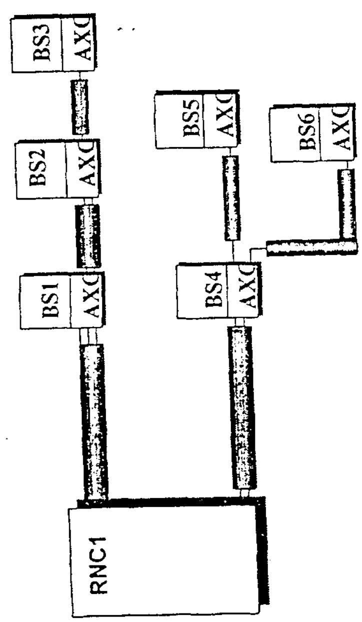
Delay Components



(Dashed box indicates potential intermediate equipment operating up and including the ATM layer)

FIG. 2

BSS/RAN area (RNC + BTSs)



INTERNATIONAL SEARCH REPORT

Inte al Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	BOLDT M ET AL: "MODELING AN ATM-BASED ACCESS NETWORK FOR 3RD GENERATION MOBILE COMMUNICATION NETWORKS" VTC'98. 48TH. IEEE VEHICULAR TECHNOLOGY CONFERENCE. OTTAWA, CANADA, MAY 18 - 21, 1998, IEEE VEHICULAR TECHNOLOGY CONFERENCE, NEW YORK, NY: IEEE, US, vol. 3 CONF. 48, 18 May 1998 (1998-05-18), pages 2590-2593, XP000903491 ISBN: 0-7803-4321-2 the whole document ---	1-12

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 September 2001	14/09/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Kreppel, J

Form PCT/ISA/210 (second sheet) (July 1992)

Inte__al Application No
PCT/EP 00/12507

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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